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1. Mathematical Programming

a. Index Method. An approximation technique.

(1) Index Number: Man Hours Required in any plant divided by least man hours of any plant.

Operations Research Methods & Problems
Sasieni Wiley

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Linear Programming

Factors in Identity and constants must be positive

a. Restrictions $\leq$ $\begin{cases} 7x + 6y \leq 84 \\ 7x + 6y + w_1 = 84 \end{cases}$

b. Requirements $\geq$ $\begin{cases} 5x + 2y \geq 15 \\ 5x + 2y - w_2 + U_1 = 15 \end{cases}$

c. Approximation $\cong$ $\begin{cases} 6x + 5y \cong 50 \\ 6x + 5y - W_3 + W_4 = 50 \end{cases}$

x	y	w_2	w_3	w_1	U_1	W_4
7	6			1		
5	2	-1			1	
6	5		-1			1
a	b	0	-1	0	-M	-1

d. Equations $\begin{cases} 3x + 4y = 100 \\ 3x + 4y + U_2 = 100 \end{cases}$

-M

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Object column	Variable column	Constant column	Body	Key column	Identity		Check column	
			2	3	0	0		objective row
			X	Y	W_1	W_2		variable row
0	W_1	30	3	4	1		38	
0	W_2	60	2	5	.	1	68	
		0	−2	−3	0	0	−5	Index row
3	Y	$\frac{30}{4}$	$\frac{3}{4}$	1	$\frac{1}{4}$	0	$\frac{38}{4}$	Main Row
	W_2	$\frac{90}{4}$	$-\frac{7}{4}$	0	$-\frac{5}{4}$	1	$\frac{82}{4}$	
		$\frac{90}{4}$	$\frac{1}{4}$	0	$\frac{3}{4}$	0	$\frac{94}{4}$	Index row

repeat iteration until no negative numbers in index row.

Index Number $= \sum$ {(number in col)(corresponding number in obj col)} − (No in object row at head of col)

$(3.0)+(2.0)-2=-2$

Key row = Dividing Constant column by Key col.

$W_1 = \frac{30}{4} = 7.5$; $W_2 = \frac{60}{5} = 12$ choose smallest

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positive ratio.

Key Number : common element in key row and key column

Main Row : divide each number in key row by key number.

$$\text{Element in new tableau} = \text{Corresponding element in old tableau} - \left(\frac{\text{corresponding element in key row} \times \text{Corresponding element in Key column}}{\text{key number}} \right)$$

$$= 60 - \left(\frac{30 \times 5}{4} \right) = \frac{90}{4} = \frac{45}{2}$$

$$= 2 - \frac{3 \times 5}{4} = -\frac{7}{4}$$

$$= 5 - \frac{4 \times 5}{4} = 0$$

$$= 0 - \frac{1 \times 5}{4} = -\frac{5}{4}$$

$$= 1 - \frac{0 \times 5}{4} = 1$$

$$= 68 - \frac{38 \times 5}{4} = 68 - \frac{190}{4} = \frac{82}{4}$$

$$= 0 - \frac{30(-3)}{4} = \frac{90}{4}$$

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Variations on Simplex Problem

Idle time process I cost \$1/2

Idle time process II Cost \$1

object row modify $2 \mid 3 \mid -\frac{1}{2} \mid -1$

~~[illegible]~~

$$2x + 3y - \frac{1}{2}w_1 - w_2 = \text{min.}$$

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maximum no of pieces $x + y = \text{max}$

objective row $1 \quad 1 \quad 0 \quad 0$

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another requirement $x = 4$

$$x + w_3 = 4$$

attach high cost to w_3 arbitrarily which would make it disappear.

minimize idle time $w_1 + w_2$ becomes $-w_1 - w_2$